## *Overview*

The Carrier Relative Humidity with Thermistor Outside Air Series utilizes a thermoset polymer capacitive sensing element with factory applied hygroscopic filter to deliver a proportional analog current or voltage output signal. The hygroscopic filter provides added resistance to moisture, dust, and other chemicals for greater long term reliability. The RH Outside Air transmitter features integral DIP switches for field selection of the proper output signal and supply voltage to meet your applications requirements. Each unit also contains 0%, 50%, and 100% test options to verify that the transmitter is both working and wired properly. Field calibration also can be performed by using the increment and decrement calibration DIP switches without the need to replace the sensing element. These enhancements provide increased flexibility and outstanding long-term reliability. Outside Air configurations feature a weatherproof Euro style enclosure with gasketed cover and conformally coated circuit boards for added moisture and chemical resistance.

**Applications**: Monitor Outdoor Air Humidity, Economizer Control, Psychrometric calculations such as Enthalpy and Dew point, Wash down Applications

## *Part Numbers*

**NSA-HH/RH2-CP-O-C** **NSA-HH/RH3-CP-O-C**

## *Specifications*

| | |
|---|---|
| **RH Supply Voltage (Reverse Polarity Protected):** | **4-20 mA**: 250 Ohm Load: 15 - 40 VDC / 18 - 28 VAC<br>**500 Ohm Load**: 18 - 40 VDC / 18 - 28 VAC<br>**0-5 VDC**: 12 - 40 VDC / 18 - 28 VAC \| **0-10 VDC**: 18 - 40 VDC / 18 - 28 VAC |
| **RH Supply Current (VA):** | **Voltage Output**: 8 mA max (0.32 VA) \| **Current Output**: 24 mA max (0.83 VA) |
| **RH Output Load Resistance:** | **4-20 mA**: 700 Ohms max \| **0-5 VDC or 0-10 VDC**: 4K Ohms min |
| **RH Output Signal:** | **2-wire**: 4 - 20 mA (default) \| **3-wire**: 0-5 or 0-10 VDC and 4 - 20 mA (Field Selectable) |
| **RH Accuracy @ 77°F (25°C):** | +/- 1% over 20% RH Range between 20 to 90% \| +/- 2%, 3%, or 5% from 10 to 95% |
| **RH Measurement Range** | 0-100% |
| **Operating RH Range:** | 0 to 95% RH, non-condensing (Conformally Coated PCB's) |
| **Operating Temperature Range:** | -40 to 140°F (-40 to 60°C) |
| **Storage Temperature Range:** | -40 to 149°F (-40 to 65°C) |
| **RH Stability \| Repeatability \| Sensitivity:** | Less than 2% drift / 5 years \| 0.5% RH \| 0.1% RH |
| **RH Response Time (T63):** | 20 Seconds Typical |
| **RH Sensor Type:** | Capacitive with Hydrophobic Filter |
| **RH Transmitter Stabilization Time:** | 30 Minutes (Recommended time before doing accuracy verification) |
| **RH Connections \| Wire Size:** | Screw Terminal Blocks (Polarity Sensitive) \| 16 (1.31 mm²) to 26 AWG (0.129 mm²) |
| **RH Terminal Block Torque Rating:** | 4.43 to 5.31 lb-in (0.5 to 0.6 Nm) |
| **RH NIST Test Points:** | **Default Test Points**: 3 Pts (20%, 50% & 80%) or 5 Pts (20%, 35%, 50%, 65% & 80%)<br>**1% NIST Test Points**: 5 Pts within selected 20% Range (ie. 30%-50% are 30, 35, 40, 45 & 50) |
| **Nominal Thermistor Resistive Output @ 77°F (25°C) (Lead Wire Colors):** | 10KΩ- (White/Green) |
| **Thermistor Accuracy 32-158°F (0-70°C):** | +/- 0.36°F (0.2°C) |
| **Thermistor Power Dissipation Constant:** | 3 mW/°C |
| **Thermistor Sensor Response Time (T63):** | 10 Seconds nominal |
| **Lead Wire Length \| Conductor Size:** | 14" (35.6 cm) \| 22 AWG (0.65 mm) |
| **Insulation \| Rating:** | Etched Teflon (PTFE) Colored Leads \| Mil Spec 16878/4 Type E |
| **Enclosure Specifications (Material, Flammability, Temperature, NEMA/IP** | **"-EH" Enclosure**: ABS Plastic; UL94-V0; -40 to 140°F (-40 to 60°C)<br>**"-4X" Enclosure**: Polystyrene Plastic; UL94-V2; -40 to 158°F (-40 to 70°C); NEMA 4X |

| | |
|---|---|
| **Rating):** | (IP 66) |
| **Sensing Tube Dimensions (Length x Diameter):** | **"-EH" Models**: 3.00" (76.20 mm) x 1.125" (28.75 mm)<br>**"-4X" Models**: 4.73" (120.14 mm) x 0.845" (21.46mm) |
| **Product Dimensions (L x W x D):** | See **Dimensional Drawing** below |
| **Product Weight:** | 0.59 lbs. (0.27 kg) |
| **Agency Approvals:** | CE, RoHS2, WEEE |

## *Dimensional Drawing*

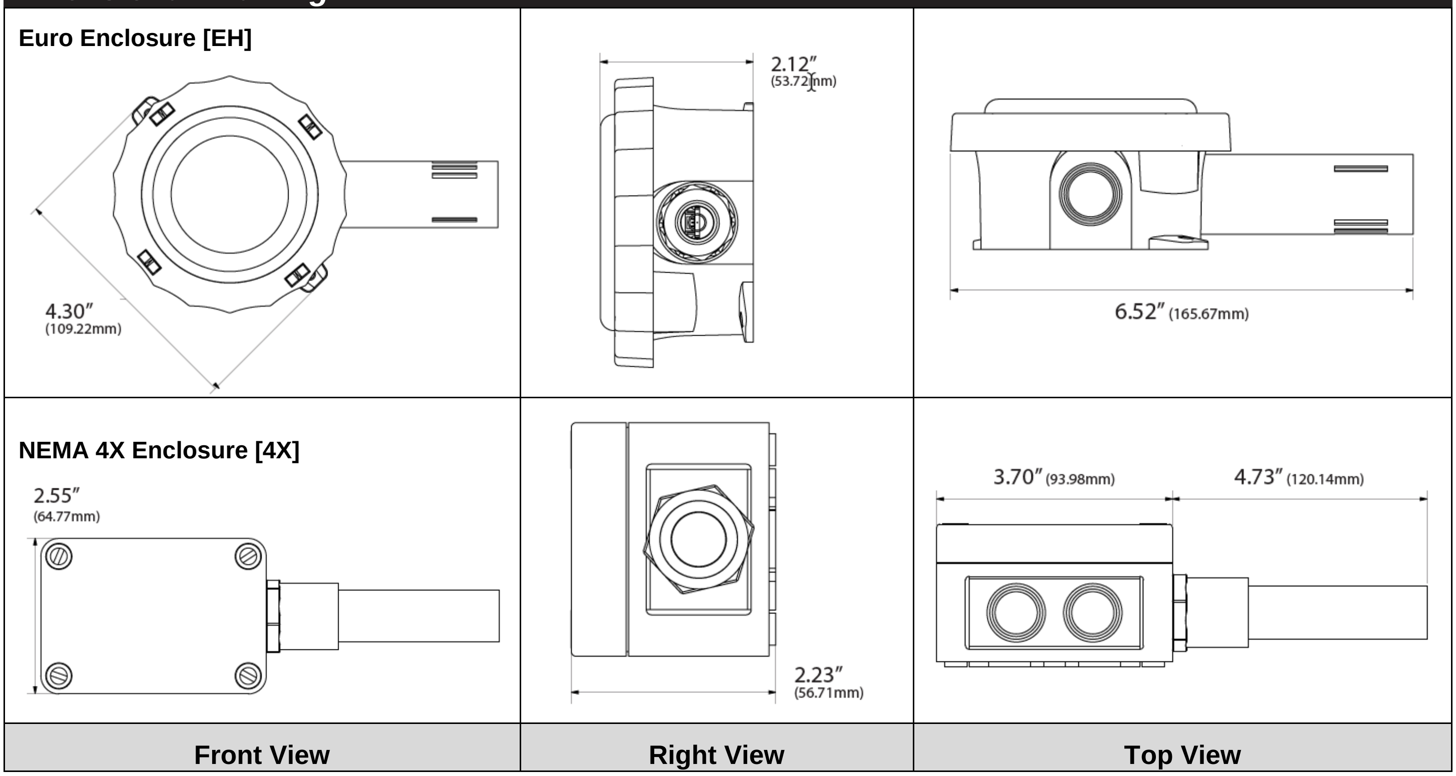



*Figure 1*

## *Installation*

**For optimal readings, follow these tips:**

- The sensor should be mounted in the middle of the duct where air circulation is well mixed (no stratification), and not blocked by obstructions. Stratification and obstructions can cause sensing errors. An example is downstream from a heating or cooling coil.
- Duct probe should be placed (3) to (4) duct segments down from any bend or obstructions and away from 90° bends.
- Mount the sensor on the top or sides of duct work; mounting on the bottom risks damage due to moisture.

### Mounting Instructions

The Euro enclosure (-EH) requires a 0.875" (22.23 mm) hole in the duct, and the Nema 4X enclosure (-4X) requires a 1.25" (31.75 mm) hole - see Figure 1**Error! Reference source not found.**. After drilling, insert the probe through the hole ntil the foam pad is tight to the duct. Drill pilot holes for the mounting screws. Use the enclosure as a guide, or use the dimensions listed on the right to measure out.

Now fasten and insert mounting screws through the mounting holes and tighten until the unit is held firmly to the duct. Refer to **Wiring Instructions** to make necessary connections.

### Mounting Dimensions

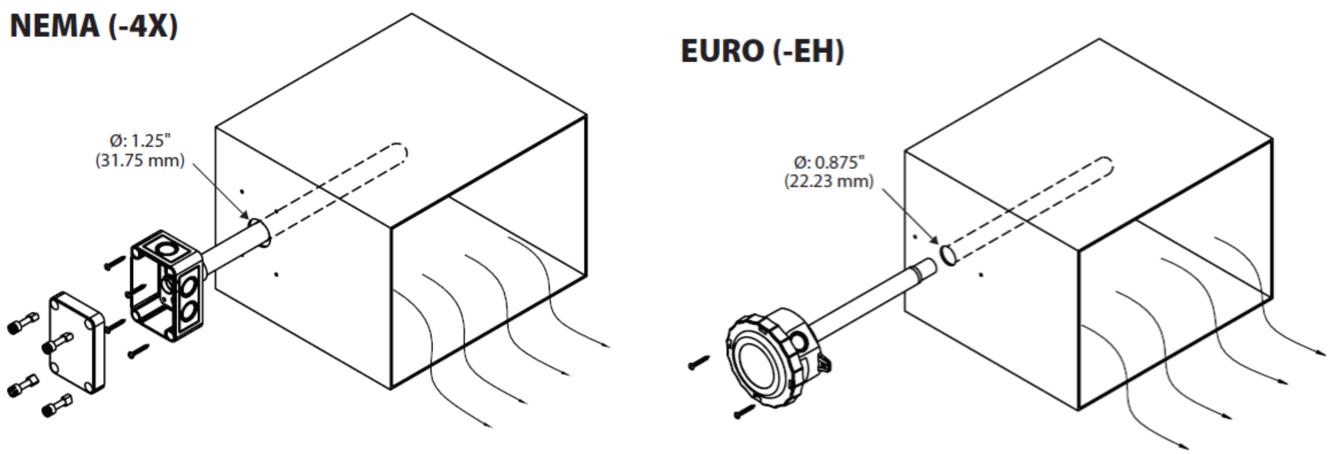



*Figure 2*

## *Wiring Instructions*

### Precautions

- Do not run the temperature sensor wiring in any conduit with line voltage (24/120/230 VAC) if utilizing resistance temperature signal.
- Remove power before wiring. Never connect or disconnect wiring with power applied.
- When using a shielded cable, ground the shield only at the controller end. Grounding both ends can cause a ground loop.
- It is recommended you use an isolated UL-listed class 2 transformer when powering the unit with 24 VAC. Failure to wire the devices with the correct polarity when sharing transformers may result in damage to any device powered by the shared transformer.
- If the 24 VDC or 24VAC power is shared with devices that have coils such as relays, solenoids, or other inductors, each coil must have an MOV, DC/AC Transorb, Transient Voltage Suppressor, or diode placed across the coil or inductor. The cathode, or banded side of the DC Transorb or diode, connects to the positive side of the power supply. Without these snubbers, coils produce very large voltage spikes when de-energizing that can cause malfunction or destruction of electronic circuits.

### Relative Humidity Wiring Instructions

Open the cover of the enclosure. Carrier recommends 16 to 26 AWG twisted pair wires or shielded cable for all transmitters. Twisted pair may be used for 2-wire current output transmitters or 3-wire for voltage output. Refer to Figure 6 for wiring diagrams.

### Temperature Wiring

Carrier recommends 16 to 26 AWG twisted pair wires or shielded cable for all temperature sensors. Carrier recommends a separate cable be pulled for Temperature signal only. Temperature Signal wiring must be run separate from low and high voltage wires (24/120/230VAC). All thermistors and RTD temperature sensors are both non-polarity and non-position sensitive. All thermistor type units are supplied with (2) flying lead wires, and all RTD's are supplied with (2) or (3) flying lead wires – see Figure 4. The number of wires needed depends on the application. Connect thermistor/RTD wire leads to controller analog input wires using wire nuts, terminal blocks, or crimp style connectors. All wiring must comply with local and National Electric Codes. After wiring, attach the cover to the enclosure.

### NOTES

- When using a shielded cable, be sure to connect only (1) end of the shield to ground at the controller. Connecting both ends of the shield to ground may cause a ground loop. When removing the shield from the sensor end, make sure to properly trim the shield to prevent any chance of shorting.
- If the controller requires a (2) wire input for a RTD, connect the (2) common wires (same color) together. If the controller requires (3) wires, use (3) individual wires - see Figure 4.

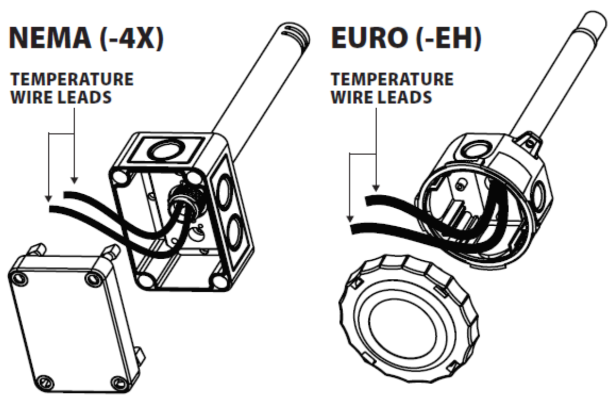



*Figure 3*

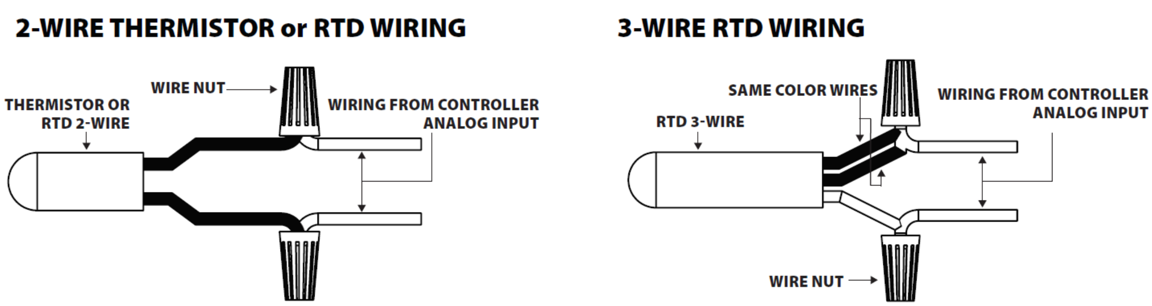
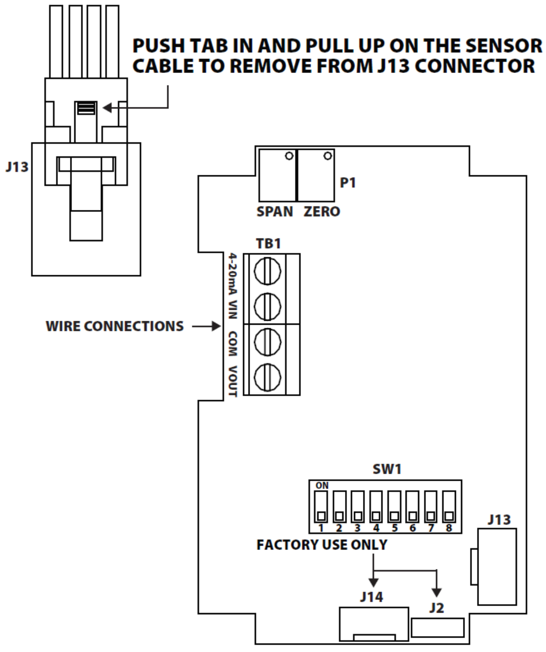



*Figure 4*

## Printed Circuit Board

### SQUARE PCB (-4X ENCLOSURE)




### ROUND PCB (-EH ENCLOSURE)

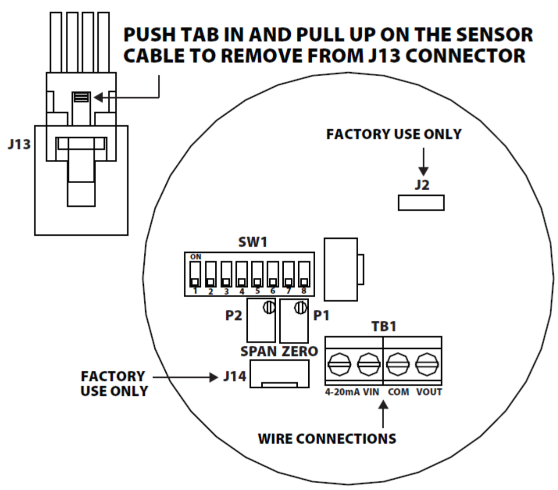
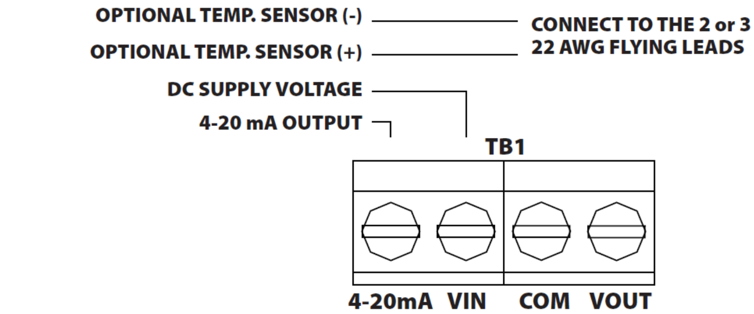


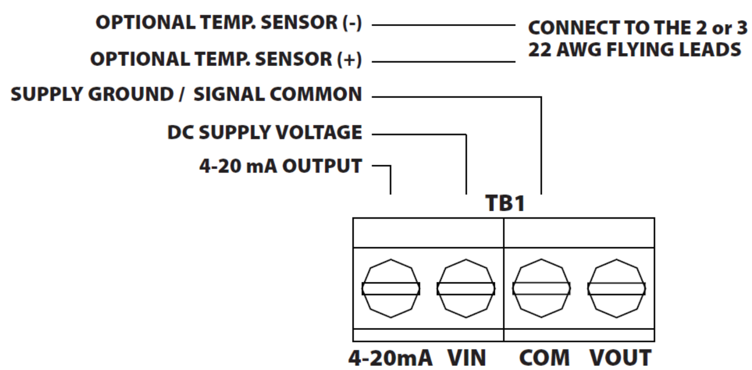

*Figure 5*

## Output Signals

### 2 WIRE CURRENT OUTPUT SIGNAL




### 3 WIRE CURRENT OUTPUT SIGNAL




### VOLTAGE OUTPUT SIGNAL

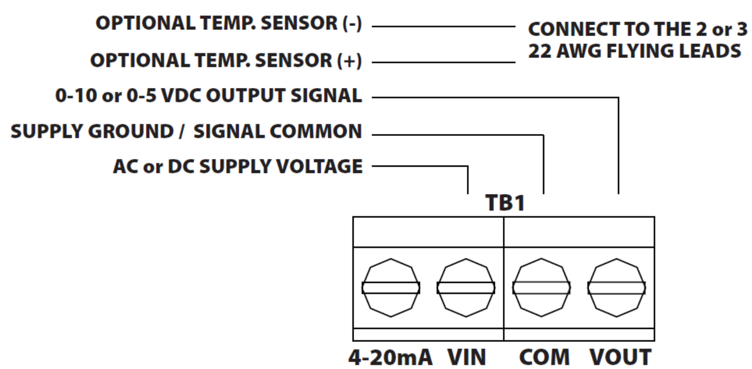



*Figure 6*

## *Output Signals*

Switches 6, 7, and 8 are used to set the RH output signal. Refer to Figure 7 for switch settings.

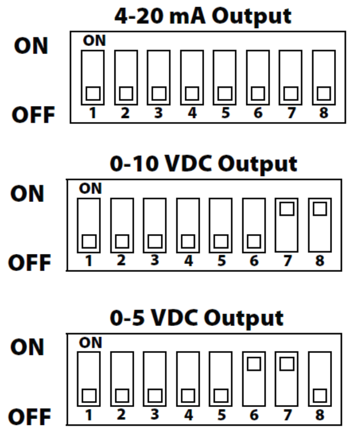



*Figure 7*

## *Humidity Reverse Acting Output*

The output is direct acting and can be changed to reverse acting mode. The output range stays the same but the corresponding RH value is opposite.

**Example**

Direct Acting (DA)

0-10 V output mode,

0 V = 0% RH and 10 V = 100% RH

Reverse Acting (RA)

0-10 V output mode,

0 V = 100% and 10 V = 0%

To change the transmitter to reverse acting or back to direct acting, set switch 4 to ON to put the unit in setup mode. After switch 4 is on, turning switch 2 to ON will put the unit in direct/reverse acting mode. When switch 2 is set to ON, the output can be used to show if the unit is in direct or reverse acting mode. For direct acting, the output will be 1 V for 0-5 V, 2 V for 0-10 V, and 7.2 mA for 4-20 mA. For reverse acting the output will be 4 V for 0-5 V, 8 V for 0-10 V, and 16.8 mA for 4-20 mA.

With switches 2 and 4 ON, each time switch 5 is set to ON the output will change to reverse acting or direct acting.

To reset the unit to the default setting, toggle both switches 5 and 6 ON then OFF while both switches 2 and 4 are ON.

When all calibration is completed, remember to place the switches back into the positions that correspond to the output needed as shown in Figure 7.

## *RH Calibration*

**NOTE** This is only a single point calibration. All transmitters are factory calibrated to meet/exceed published specifications. Field adjustment should not be necessary. The dipswitch allows the user to calibrate the sensor through the software. Setting switch 4 ON will put the transmitter into setup mode allowing the increment and decrement to work.

Once in setup mode, the output will change to 50% (2.5 V for 0-5 V, 5 V for 0-10 V, 12 mA for 4-20 mA). Each increment or decrement step will cause the output to change by 0.1 V for 0-5 V, 0.2 V for 0-10 V, and 0.32 mA for 4-20 mA in setup mode. This can be used to show the user how far offset the transmitter is. To see the starting point again set switch 1 ON. This will show the 50% output again. When the unit is out of setup mode the output will go back to RH output. The maximum offset is 10%. There can be a total of 20 increments.

### Increment RH Output

This will shift the RH output linearly up in 0.5% steps. Switch 4 must be set to ON first. After switch 4 is on, each time switch 5 is set ON the RH output will increase by 0.5%. The increase goes into effect each time switch 5 is set to ON.

### Decrement RH Output

This will shift the RH output linearly down in 0.5% steps. Switch 4 must be set to ON first. After switch 4 is on, each time switch 6 is set ON the RH output will decrease by 0.5%. The decrease goes into effect each time switch 6 is set to ON.

### Reset RH Output

This will reset the RH output back to the original calibration. Switch 4 must be set to ON first. After switch 4 is on, toggle switches 5 and 6 ON then OFF. After 5 and 6 are OFF, slide switch 4 OFF.

When all calibration is completed, remember to place the switches back into the positions that correspond to the output needed as shown in Figure 7.

## *Test Instructions*

Test mode will make the transmitter output a fixed 0%, 50%, or 100% value. The sensor will not affect the transmitter output. This is used for troubleshooting or testing only. Switches 1, 2, and 3 are used for test mode. The output will be a fixed 0%, 50%, or 100% signal that corresponds to the output selected with switches 6, 7, and 8. Refer to Figure 8 for switch settings.

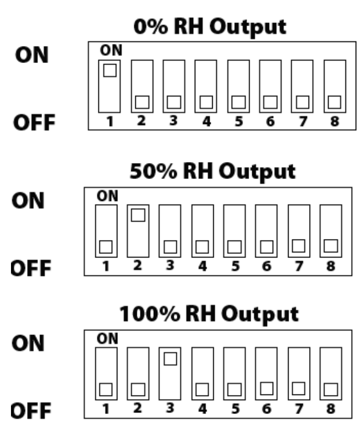



*Figure 8*

## *RH Conversion Formulas*

| | 4-20 mA | 0-5 VDC | 0-10 VDC |
|---|---|---|---|
| **Formula:** | ([mA signal] -4) / 0.16 = % RH | [VDC signal] / 0.05 = % RH | [VDC signal] / 0.10 = % RH |
| **Example:** | 12 mA output signal<br>(12 - 4) / 0.16 = 50% RH | 1.25 vdc output signal<br>1.25 / 0.05 = 25% RH | 7.50 vdc output signal<br>7.50 / 0.10 = 75% RH |

## *W.E.E.E. Directive*

At the end of their useful life the packaging and product should be disposed of via a suitable recycling center. Do not dispose of with household waste. Do not burn.

## *Troubleshooting*

| Humidity Reading Problem | Solution |
|---|---|
| No Reading | • Check that you have the correct supply voltage at the power terminal blocks.<br>• Check that wiring configurations and all DIP switch settings are as in Figure 6 and Figure 7.<br>• Verify that the terminal screws are all connected tightly and that all of the wires are firmly in place. |
| Erratic readings | • Verify that all of the wires are terminated properly.<br>• Make sure that there is no condensation on the board.<br>• Check that the input power is clean. In areas of high RF interference or noise, shielded cable may be necessary to stabilize signal. |
| Inaccurate readings | • Verify proper mounting location to confirm no external factors (see mounting locations above).<br>• Check the output (voltage or current) against a highly accurate recently calibrated secondary reference. Measure RH at the location of the sensor using the secondary reference, then calculate the RH percentage using the **RH Conversion Formulas** -page 8. Compare the calculated output to reference.<br>• If the sensor is brand new, leave the sensor powered for at least 30 minutes to stabilize.<br>• If you suspect that the transmitter is not reading within the specified tolerance, please contact Carrier for further assistance. |

| Temperature (Optional) Problem | Solution |
|---|---|
| Sensor reading is incorrect | • Verify sensor wiring to controller is not damaged and has continuity<br>• Verify sensor or wires are not shorted together<br>• Verify controller is setup for correct sensor curve<br>• Disconnect sensor wires, and take a resistance (ohm) reading with a multimeter<br>• Compare the resistance reading to the Temperature Vs Resistance Curves online: http://www.workaci.com/content/thermistor-curves-0<br>• Verify proper mounting location to confirm no external factors |
| Sensor reads infinity/very high resistance | Sensor or wires are open |
| Sensor reads low resistance | Sensor or wires are shorted together |
| Erratic readings | Bad wire connections |